

STATEMENT OF WORK
FOR THE NOAA - K, L, M, N, N', AND, MetOp
ADVANCED VERY HIGH RESOLUTION RADIOMETER/3
(AVHRR/3) ,
HIGH RESOLUTION INFRARED RADIATION SOUNDER/3
(HIRS/3) ,
AND
HIGH RESOLUTION INFRARED RADIATION SOUNDER/4
(HIRS/4)

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AND
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(HIRS/4)

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DOCUMENT CHANGE NOTICE

CCR NO.	CCR DATE	MOD NO.	MOD DATE	SECTION
Initial, 1147, 1211, 1413A, 1557A	08/13/87, 03/22/93, 12/23/93, 11/05/96, 06/17/98	52, 58, 98, 116	03/30/94, 01/11/94, 04/23/97, 06/22/98	All, 3.1, Appendix A, Appendix A, 3.1, 5.2
Revision History For S-480-78.0				
Initial	08/25/93	63	05/05/94	All
1321	05/30/95	79	09/20/95	8.2.1
1351A	02/07/96	84	02/26/96	8.1.3
1376	03/15/96	86	04/08/96	10.0
1556A	06/17/98	115	06/22/98	8.2.2, 9.2.2
1557A	06/17/98	116	06/22/98	(Global changes all), 1.1.2, 2.2, 3.1, 8.1.1, 8.1.2, 8.1.3, 8.2.1, 9.1.1, 9.1.2, 9.2.1, 9.3, Appendix B
1552A	08/14/98	120	08/19/98	9.1.1, 9.1.2
(Technical Memo)				
1552A	08/27/98	123	09/04/98	8.1.2, 9.1.2
Initial1413A	11/05/96	124	10/16/98	All
1577	01/16/99	133	02/05/99	2.2, 8.2.2, 9.2.2
1499	01/07/98	135	02/24/99	12.0
1608	03/22/99	136	03/18/99	3.1.1
1589A	03/12/99	137	03/24/99	9.1.4
1608	03/22/99	138	04/30/99	3.1.1
1656	09/09/99	146	09/09/99	8.1.2.1, 9.3.1
1592	05/26/99	158	03/28/00	8.3, 8.3.1, 9.4, 9.4.1
1728A	07/20/00	165	08/03/00	9.1.3.1
1727	05/21/00	170	09/11/00	8.2.2, 9.2.2
1618A	06/30/99	177	02/07/01	8.1.2, 9.1.3
1751	08/22/00	169	10/02/00	8.1.2, 9.1.3
1729a	03/22/01	185	04/03/01	8.1.2.2, 8.1.2.3, 9.3.2, 9.3.3
1836	07/20/01	192	07/19/01	8.1.2.4
1762	10/10/00	184	04/02/01	10.1
1587a	07/19/01	195	09/09/01	7.0
1663	02/21/00	167	08/22/00	8.2.1

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STATEMENT OF WORK
FOR THE NOAA - K, L, M, N, N', AND, MetOp

ADVANCED VERY HIGH RESOLUTION RADIOMETER/3 (AVHRR/3),
HIGH RESOLUTION INFRARED RADIATION SOUNDER/3 (HIRS/3),
AND
HIGH RESOLUTION INFRARED RADIATION SOUNDER/4 (HIRS/4)

1.0 INTRODUCTION

This procurement provides for the design, fabrication, test, qualification, and delivery of eight (8) flight model AVHRR/3, three (3) flight model HIRS/3, four (4) flight model HIRS/4, and one (1) HIRS/4 Engineering Test Model (ETM). The AVHRR/3 and HIRS/3 instruments will be similar to those built by ITT A/CD under GSFC contracts NAS5-26771 (AVHRR/2) and NAS5-26954 (HIRS/2I). An AVHRR/3 instrument will fly on each of the NOAA - K, L, M, N, and N' missions, and three (3) will be supplied for the MetOp-1 and MetOp-2. A HIRS/3 instrument will fly on each of the NOAA-K, L and M missions and a HIRS/4 will fly on each of the NOAA-N, and N' missions, two (2) each will be supplied for the MetOp-1. In addition, to accommodate the MetOp requirements: one (1) Portable Test Unit (PTU), one (1) Bench Test Cooler (BTC) and support fixture, and instrument handling fixture, are to be provided for the HIRS instrument and one (1) Portable Test Unit (PTU), one (1) Bench Test Cooler (BTC) and support fixture, and instrument handling fixture, are to be provided for the AVHRR instrument.

1.1 INSTRUMENT DESCRIPTION

1.1.1 AVHRR/3

The AVHRR/3 instrument will consist of a six-channel Earth-scanning radiometer for high-resolution visible and infrared data acquisition of sea surface temperature, ice, snow, and cloud information.

1.1.2 HIRS/3

The HIRS/3 instrument will consist of a discrete stepping, line-scan instrument designed to measure scene radiance in 20 spectral bands to permit the calculation of the vertical temperature from the Earth's surface to the upper stratosphere and the water vapor content from the surface to the tropopause. It will have one visible channel designed for cloud detection. This instrument, in conjunction with others, will provide measurements from which global atmospheric temperature and water vapor profiles may be determined.

1.1.3 HIRS/4

Same as HIRS/3 except the HIRS/4 instruments will have a Field-of-View (FOV) of 10KM instead of the HIRS/3's 20KM FOV.

2.0 REFERENCES

The documents specified below shall control the work to be conducted in accordance with this Statement Of Work. The documents form part of this Statement Of Work to the extent and manner described herein and are made a part thereof by reference.

2.1 REVISIONS

When the applicable documents are revised, the contractor is encouraged to follow, and authorize his subcontractors to follow the applicable portions of the revised publication. However, the contractor is not required to comply with revisions made after the award date of the contract, except as a contract change.

2.2 NASA DOCUMENTS

S-480-81: Performance Specification For the NOAA K, L, M, N, N' & MetOp Advanced Very High Resolution Radiometer/3 (AVHRR/3) Flight Models A301, A302, A303, A304, A305, A306, A307, and A308

S-480-82: Performance Specification For the NOAA-K, L, M, N, N' & MetOp High Resolution Infrared Radiation Sounder/3/4 (HIRS/3/4) Flight Models H301, H302, H303, H304, H305, H306, and H307

S-480-29.1 Revision G: Performance Assurance Requirements (PAR) for the NOAA-K, L, & M Advanced Very High Resolution Infrared Radiometer/3 (AVHRR/3) and High Resolution Infrared Radiation Sounder (HIRS/3), and the PAR Clarification Addendum

S-480-95: Transportable Bench Check Unit (TBCU) Requirements

S-480-96: Clarifications of the PLM EGSE Internal Interface Control Document for the AVHRR and HIRS Instruments

NAS5-30384: AVHRR/3 and HIRS/3, and HIRS/4 Procurement Contract

GHB 5112.1: Performance Measurement System (PMS) Handbook, August 1988

2.3 ITT DOCUMENTS

ITT CMP-16603: Configuration Management

3.0 GENERAL REQUIREMENTS

3.1 OVERVIEW

The contractor shall provide the material, services, equipment, and personnel necessary to fabricate, test, calibrate, and document the AVHRR/3 (FM A301, A302, A303, A304, A305, A306, A307 and A308), the HIRS/3 (FM H301, H302, and H303), the HIRS/4 (FM H304, H305, H306, and H307), and the HIRS ETM instruments. This effort shall be conducted in accordance with the GSFC specifications S-480-81, Advanced Very High Resolution Radiometer/3 (AVHRR/3); S-480-82, High Resolution Infrared Radiation Sounder/3/4 (HIRS/3/4); S-480-29.1 Rev. G, Performance Assurance Requirements for the AVHRR/3 and HIRS/3/4 and its Clarification Addendum.

The contractor shall upgrade the AVHRR/2 and HIRS/2I bench check units by replacing the obsolete computers in them and completely rebuilding the HIRS/2I bench check unit. Existing suitcase testers, environmental and performance test equipment, currently accounted for under NAS5-29114, will be made available for use on this contract. The Portable Test Unit (PTU)/suitcase tester for the HIRS/3/4 will be functionally upgraded by interfacing with a PC to perform additional tests similar to those of the Bench Check Unit (BCU), within the practical capability of this enhancement. Additional Bench Test Coolers will be fabricated for both the AVHRR/3 and HIRS/3/4. Additional equipment of this type will be built for the MetOp requirements. This equipment is listed in the contract deliverable requirements list as MetOp.

The contractor shall support the design and other reviews described in the AVHRR/3 and HIRS/3/4 Performance Assurance Requirements (PAR) specification and its Clarification Addendum. The contractor shall provide such information and support as required in the specifications of this contract which are necessary for the Government to monitor the contractor's technical, schedule and cost progress.

3.1.1 TASK ORDER REQUIREMENTS

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The contractor shall provide special studies related to significant anomaly support above and beyond that specified in paragraph 10.1.1 and 10.2.2 for the HIRS and the AVHRR instruments and ground support equipment. Including but not limited to: 1) trouble-shooting and/or significant anomaly analysis, and 2) on-orbit anomaly TIROS On-orbit Anomaly Report (TOAR) activities. These shall be directed as specified in clause H.21 TASK ORDERING PROCEDURE of the contract.

3.2 TERMINOLOGY

Appendix A contains a list of acronyms and definitions.

4.0 DELIVERABLE ITEMS

The contractor shall provide deliverables as specified in the contract deliverable requirements list for NOAA-N, N', and MetOp.

5.0 NOAA-K, L, M, N, N', & MetOp PROGRAM

The contractor shall provide for overall management of the AVHRR/3 and HIRS/3/4 contract effort. The contractor shall have a program office with responsibility for all aspects of the conduct of this contract.

5.1 PROJECT PLANNING

The contractor shall provide for the technical, schedule and fiscal planning required to implement the requirements of this addition to the contract.

5.1.1 WORK BREAKDOWN STRUCTURE

The Work Breakdown Structure proposed in ITT proposal 19032 currently in use, shall be the basis for NASA Form 533 series reporting. The contractor may make adjustments to it, by mutual agreement with GSFC, to better reflect the contractor's organization of work on this contract.

The prime contractor shall be responsible for traceability of subcontractor data supporting its WBS elements. The prime contractor may establish with a subcontractor any WBS that permits the prime contractor to fulfill his WBS requirements and that provides adequate control of the subcontract.

5.2 MONTHLY REPORTING

The contractor shall submit a weekly progress report describing the progress made during the reporting period. The report is to be prepared on a weekly basis and submitted electronically to a GSFC supplied distribution list.

The weekly report shall cover the status of the technical, schedule, configuration management, performance assurance and contracts aspects of the contract. It shall be consistent with the detailed requirements described in S-480-81 and S-480-82.

When no instrument is in manufacturing or testing at the contractor's facility, the weekly report will be substituted with a monthly report of similar content.

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5.3 MEETINGS AND REVIEWS

5.3.1 DESIGN REVIEWS

The contractor shall conduct the formal GSFC and informal internal design reviews required in the PAR document. The contractor shall also conduct informal program and technical reviews for the GSFC Technical Officer at the Technical Officer's request.

The contractor shall conduct a formal review which addresses the changes to the HIRS/3/4 and AVHRR/3 instruments. The review will specifically include an

overview of the instruments, equipment, and documentation to be provided to the European MetOp program and address in detail the interfaces (thermal, electrical, and mechanical). The design of the ground support equipment (Bench Test Equipment (BTE), etc.) shall be discussed in detail. Representatives of the European Space Agency (ESA) and EUMETSAT can be expected to attend the review.

5.3.2 QUARTERLY PROJECT STATUS MEETING

The contractor shall present nominally half-day long formal project status meetings for the upper management of the GSFC POES Project Office at the contractor's facility. These meetings will be attended by approximately 10 NOAA and NASA personnel.

When no instrument is in manufacturing or testing at the contractor's facility, the frequency of the Project Status Meetings will be yearly.

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5.4 CONFIGURATION MANAGEMENT

5.4.1 PROGRAM AND PLAN

The contractor shall maintain an approved configuration management (CM) plan similar to that described in ITT document No. CMP-16603. The CM plan shall be in force throughout the life of this contract. Configuration control procedures shall be exercised following completion of the first flight model testing.

5.4.2 CONFIGURATION MANAGEMENT DOCUMENTATION

Configuration management program status reports shall be submitted by the contractor as part of the monthly progress report. Documentation shall be submitted as specified in the contract subject to actions of GSFC as indicated.

Proposed changes that require either review or approval by the GSFC POES Project Configuration Control Board (CCB) shall be classified as follows:

5.4.2.1 Class I Change

Requires GSFC approval. Any changes that impacts the GSFC specified technical performance requirements, technical interface, or cost and schedule requirements is defined as a Class I change.

Class I changes originated by the contractor and/or a subcontractor shall be documented on POES Configuration Change Requests, Form GSFC 480-39, and shall be submitted to the GSFC POES Project CCB for approval before implementation.

5.4.2.2 Class II Change.

Requires GSFC review. A change shall be classified Class II when it does not fall within the definition of a Class I change. Class II changes do not require GSFC concurrence before implementation. Examples of Class II changes are changes in documentation only (e.g., correction of errors, addition of clarifying notes or views) or change in hardware that does not affect any factor listed under Class I changes.

Class II changes originated by the contractor and approved by the contractor's CCB shall be submitted on the contractor's internal change forms for GSFC review.

6.0 PROGRAM MANAGEMENT

The contractor shall provide for the administration of personnel on the contract. The contractor shall provide technical and resource management for the life of this Addition to the contract.

6.1 TECHNICAL MANAGEMENT

The contractor shall provide an AVHRR/3 Project Engineer and a HIRS/3/4 Project Engineer. Each shall have full authority over all technical aspects of the development of his respective instrument activity.

6.2 RESOURCES MANAGEMENT

The contractor shall provide the necessary financial planning and personnel to successfully implement the requirements of this contract. Monthly and Quarterly 533 reports shall be generated and sent to GSFC by the tenth day of the month. Cost elements (including hours) shall be broken down to level III of the work breakdown structure. 533 reports shall be provided in hardcopy and, if possible, in IBM PC compatible 3.5 inch DSHD diskettes in ASCII or Excel format approved by the GSFC Technical Officer.

6.2.1 PERFORMANCE MEASUREMENT SYSTEM

The PMS for cost and schedule control requirements shall be in accordance with GBH 5112.1.

7.0 DOCUMENTATION

The contractor shall provide the documentation as specified in the contract, the Performance Assurance Requirements, and the Performance Specifications for these additional items. Also, the contractor shall supply HIRS/3/4 relative spectral response data on IBM PC 3.5 inch DSHD compatible diskettes as well as in graphical form. Alignment and Calibration Book tables for each AVHRR/3 and HIRS/3/4 instrument shall also be provided on IBM PC compatible 3.5 inch DSHD diskettes in formats approved by the GSFC Technical Officer.

The contractor shall provide instrument test data obtained throughout instrument testing on an FTP site as requested by NASA that can be accessed by authorized outside users.

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8.0 AVHRR/3 INSTRUMENTS, GROUND SUPPORT EQUIPMENT

8.1 FLIGHT MODELS

8.1.1 NOAA-K, L, M, N & N'

The contractor shall design, fabricate, calibrate, test and deliver five (5) flight AVHRR/3 instruments in accordance with the specifications shown in GSFC-S-480-81. The contractor shall provide storage facilities for temporary storage of completed instruments as required.

8.1.2 MetOp INSTRUMENTS

The contractor shall design, fabricate, calibrate, test and deliver three (3) flight AVHRR/3 instruments for the MetOp program in accordance with the specifications shown in GSFC-S-480-81. MetOp designated instruments shall be A305, A307, and A308. The contractor shall provide storage facilities for temporary storage of completed instruments as required.

The MetOp instruments shall be tested in their MetOp configurations whenever possible. At a minimum, EMI and calibration tests shall be performed in the MetOp configuration.

The performance of the third MetOp delivered instrument shall be verified in both the MetOp and POES configurations. As a minimum, EMI and calibration tests shall be performed in both configurations.

8.1.2.1 MetOp Engineering Model

The contractor shall modify one AVHRR to satisfy the following MetOp requirements. This AVHRR will be used as the MetOp Engineering Model. The AVHRR

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shall be returned to ITT after its use as the engineering model to be upgraded to a flight model.

Make necessary structural modifications to the baseplate to accommodate MetOp supplied heaters, thermostats, and thermistors and bond this hardware to the baseplate.

The thermal blanket foil shall carry a conductive layer. Each electrically conductive layer of MLI shall be grounded to structure. Surfaces which are smaller than 100 cm² do not need to be grounded to structure. The number of bonding points per sheet of MLI material shall be at least two points, at diagonal corners. The DC resistance between the MLI bonding point and any point belonging to the metallized face of any foil shall be less than 50 Ω .

Provide connector savers.

The magnetic materials with their magnetic characteristics shall be listed.

Provide a flight cover for the J33 connector.

Provide additional MetOp specific information for the MetOp EM preship review, in an as agreed upon format by ITT/NASA/NOAA. (This is in addition to the POES preship package.)

8.1.2.2 MetOp Flight Models

The contractor shall make modifications necessary to the MetOp Flight AVHRR instruments to satisfy the following MetOp requirements.

Provide connector savers.

The thermal blanket foil shall carry a conductive layer. Each electrically conductive layer of MLI shall be grounded to structure. Surfaces which are smaller than 100 cm² do not need to be grounded to structure. The number of bonding points per sheet of MLI material shall be at least two points, at diagonal corners. The DC resistance between the MLI bonding point and any point belonging to the metallized face of any foil shall be less than 50 Ω .

Provide a flight cover for the J33 connector.

8.1.2.3 MetOp Required Acceptance Data Package

In addition to the POES end item data package, the following shall be provided for each MetOp instrument with the instrument deliveries. This package shall be provided in electronic format on a CD ROM.

- Declared Component List. All components to be used in the MetOp Instrument Interface shall be listed in a Declared Component List.
- Acceptance Data Package. The Acceptance Data Package shall constitute the basis for formal acceptance of each deliverable item and shall be delivered within 30 days of the instrument delivery. The contents of this package are defined below.
 - Table of Contents
 - Shipping documents/equipment identification
 - Certificate of Conformance (w.r.t. MetOp ICD) -- this will be in the form of a Compliance Matrix
 - As built configuration status list
 - Interface drawings (other drawings may be delivered as necessary)
 - Non-conformance reports (without analysis) (w.r.t. CFI ICD)

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- Deviations and waiver requests (w.r.t. CH ICD)
- Test reports or test summary reports
- Operations and maintenance manuals to cover procedures for:
 - Packing/unpacking
 - Incoming inspection
 - Mechanical integration and alignment, if any (complementary inputs in support of system level procedures)
 - Electrical integration (complementary inputs in support of system level procedures)
 - Health check (complementary inputs in support of system level procedures)
 - Instrument specific inputs for system level testing (e.g., TB/TV test, EMC test)
 - Special operations (e.g., mechanism locking/unlocking, pyro testing, red tag item removal/installation, green tag item installation)
 - Safety procedures
 - Flight operation manual for the MetOp configuration including instruments inputs to system database (includes in-orbit and ground operations)
 - Instrument calibration database
- Open work/deferred work/open tests
- Historical record sheets (logbooks) including operating time/cycles records, connectors mating records
- Age sensitive items records/life limited items status list
- Safety
 - Residential hazards sheet (if applicable)
 - Proof load certificates for handling equipment
- Declared materials and processes lists (for cleanliness/contamination issues)
- EMI test Procedures and data sheets for Radiated Susceptibility, Radiated Emissions, Conducted Susceptibility and Conducted Emissions.
- Alignment Chart with field of view alignment data.
- Vibration test procedures and data sheets, including post vibration plots.
- Instrument on time log, to be used during continuing use to the spacecraft.
- Connector mate/demate log, to be used during continuing use on the spacecraft.
- Procedures for the following operations:

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- o Installation of the optical cube
- o Blanket installation
- o Dust cover installation
- o Bagging the instruments

8.1.2.4 Sine Vibration Characterization Test

The contractor shall perform a nondestructive characterization test on a MetOp flight AVHRR to characterize its structural performance under a sine sweep vibration environment. The input shall be as high as possible, up to the MetOp sine sweep specification as called out in the MetOp ICD, and limited in magnitude to a level that will not damage the instrument. The test shall be performed from 0 to 100 Hz in each of three axes.

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A test plan shall be approved by NASA prior to beginning the test. After the completion of the test, a test report shall be delivered. Using data from the tests, the AVHRR finite element model shall be correlated and used to repeat the structural analysis of the AVHRR, where necessary. The finite element model shall then be delivered.

8.1.2.5 Sine Vibration Requirement for AVHRR

The flight MetOp AVHRRs shall be upgraded to survive the notched sine vibration profile that was used for the A307 sine vibration test as documented in Appendix B of GSFC S-480-159, Table 1. As part of their acceptance testing, the A305 and the A308 shall each be subjected to an acceptance level sine vibration test. The unnotched acceptance levels are obtained by reducing the qualification levels defined in GSFC S-480-159 by a factor of 1.25. The levels for testing shall be notched as required to insure a nondestructive test. These notches may be specific for each instrument to accommodate each instrument's unique cooler

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assembly natural frequency. The sine vibration acceptance test for the A305 and A308 shall be preceded by a sine signature sweep from 5 to 150 Hz. Instrumentation shall be utilized to characterize significant structural modes up to 150 Hz.

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8.1.3 AVHRR SCAN MOTOR DEVELOPMENT

The contractor shall design, fabricate, and test Brushless DC motors and associated closed loop control systems for the AVHRR instruments. The scan motor shall meet all requirements of GSFC-S-480-81, and shall be designed as a direct modular replacement for the hysteresis synchronous scan motors on the A303, A305 and higher flight models and used as a flight spare.

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8.2 AVHRR/3 GROUND SUPPORT EQUIPMENT

8.2.1 POES GROUND SUPPORT EQUIPMENT

The contractor shall use ground support equipment to build and test the AVHRR/3 per S-480-81, Performance Specification for the NOAA-K, L, & M, N, N' and MetOp Advanced Very High Resolution Radiometer/3 (AVHRR/3). The contractor may use existing GFE Ground Support Equipment (GSE) or develop new items to replace existing GFE GSE items that become obsolete, or become unavailable due to needs at the MetOp facility.

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8.2.2 MetOp GROUND SUPPORT EQUIPMENT

The contractor shall provide the ground support equipment for implementing the test requirements identified in S-480-95 Transportable Bench Check Unit

Requirements and S-480-96 Clarifications of the PLM EGSE Internal Interface Control Document for the AVHRR and HIRS Instruments. GSE should be sufficient to support satellite level instrument testing that is performed in parallel at two MetOp facilities. The contractor shall also provide handling equipment and procedures for the safe transportation and handling of the AVHRR and the GSE at MetOp test sites and launch sites (as needed). The contractor shall provide supporting documentation, drawings, and training on the use of this GSE at the appropriate MetOp location.

8.3 MetOp SPECIFIC ACTIVITIES

8.3.1 RADIATED EMISSIONS AND CONDUCTED EMISSIONS TESTS

The contractor shall augment the AVHRR test program to include special MetOp EMC characterization tests. Specifically, the contractor will add MetOp unique emissions tests and/or augmentations to existing POES based test procedures to cover not only all the GIIS/UIS requirements, but also the emissions tests requirements per the MetOp AVHRR ICD (MO-IC-MMT-AH-0001, Rev. A, sections 4.3.1.1 and 4.3.1.3). Facility limitations applicable to the baseline test program will be acceptable. The test results are to be documented in a special test report for each instrument and results are for characterization purposes only.

9.0 HIRS/3/4 INSTRUMENTS, GROUND SUPPORT EQUIPMENT

9.1 FLIGHT MODELS

9.1.1 NOAA-K, L & M

The contractor shall design, fabricate, calibrate, test and deliver three (3) flight HIRS/3 instruments in accordance with the specifications shown in GSFC-S-480-82. The contractor shall provide storage facilities for temporary storage of completed instruments as required.

9.1.2 NOAA-N & N'

The contractor shall design, fabricate, calibrate, test and deliver two (2) flight HIRS/4 instruments in accordance with the specifications shown in GSFC-S-480-82. The contractor shall provide storage facilities for temporary storage of completed instruments as required.

9.1.3 MetOp INSTRUMENTS

The contractor shall design, fabricate, calibrate, test and deliver two (2) flight HIRS/4 instruments for the MetOp program in accordance with the specifications shown in GSFC-S-480-82. MetOp designated instruments shall be H306 and H307. The contractor shall provide storage facilities for temporary storage of completed instruments as required.

The MetOp instruments shall be tested in their MetOp configurations whenever possible. At a minimum, EMI and calibration tests shall be performed in the MetOp configuration.

9.1.3.1 Nonsynchronous MetOp Clocks

The contractor shall make modifications necessary to the MetOp HIRS instruments, HETM, H306 and H307 to satisfy the following MetOp requirements.

The 1.248 MHz clock and the 8.32 kHz are derived from a free running oscillator in the NIU. The 1 Hz Clock, the major Frame Sync. (32 s), and the Cal. Pulse (256 s) are derived in the NIU from the OBDH Bus Broadcast Pulse. The OBDH Bus Broadcast Pulse is generated by the oscillator in the CCU on the Service Module. The leading edge of these pulses will be phase correlated to the 1.248 MHz Clock.

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Each of these two oscillators has its own initial setting failure, temperature drift and aging. This will result in a tolerance of the number of clocks per Sync. Pulse period as depicted in the table below. The specified tolerances are the maximum tolerances during mission lifetime and over nominal temperature range conditions.

	Sync 0.1 s	Sync. 1 sec	Sync. 32 sec	Sync. 256 sec
No. of 1.248 MHz cycles	124800 \pm 150*	1248000 \pm 80	39936000 \pm 4793	319488000 \pm 38339
No. of 8.32 kHz cycles	832 \pm 1*	8320 \pm 1	266240 \pm 32	266240 \pm 256

*Tolerance figure for last (10th) 0.1 s period of a 1 s cycle only. For the 9 first cycles the tolerance figure is ± 0 . The tolerance range does not affect MetOp specified data transfer.

9.1.4 HIRS SPARE SCAN MOTOR

The contractor shall modify the existing spare HIRS Scan Motor with an improved shaft material so that the HIRS/4 instrument can survive the vibration profile as shown below. The modified scan motor shall be compatible with all internal interface requirements between the motor and the current HIRS/3 or /4 design.

Frequency Range (Hz)	Power Spectral Density (g ² /Hz)	G-RMS	Duration (min/axis)
20	0.01	6.8	1.0
20-80	+3dB/oct		
80-500	0.04		
500-2000	-3dB/oct		
2000	0.01		

9.1.5 HIRS FILTER WHEEL MOTOR ANOMALY INVESTIGATION Filter

Using the spare HIRS filter wheel motor and the filter wheel motor from the H307 instrument, the contractor shall study and report on how the filter wheel motor performance can achieve a period monitor variation of less than plus or minus 2 from the nominal count value. The contractor shall consider Assembly procedures, mechanical tolerances, and differences in bearings. Multiple motor assemblies and tests shall be performed during the study.

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9.2 HIRS/3/4 GROUND SUPPORT EQUIPMENT

9.2.1 POES GROUND SUPPORT EQUIPMENT

The contractor shall use ground support equipment to build and test the HIRS, per S-480-82, Performance Specification For the NOAA-K, L, M, N, N' & MetOp High Resolution Infrared Radiation Sounder/3/4 (HIRS/3/4). The contractor may use existing GFE Ground Support Equipment (GSE) or develop new items to replace existing GFE GSE items that become obsolete.

9.2.2 MetOp GROUND SUPPORT EQUIPMENT

The contractor shall provide the ground support equipment for implementing the test requirements identified in S-480-95 Transportable Bench Check Unit Requirements and S-480-96 Clarifications of the PLM EGSE Internal Interface Control Document for the AVHRR and HIRS Instruments. GSE should be sufficient to support satellite level instrument testing that is performed in parallel at two MetOp facilities. The contractor shall also provide handling equipment and procedures for the safe transportation and handling of the AVHRR and the GSE at MetOp test sites and launch sites (as needed). The contractor shall provide supporting documentation, drawings, and training on the use of this GSE at the appropriate MetOp location.

9.3 HIRS/4 ENGINEERING TEST MODEL

The contractor shall design, fabricate, calibrate, test and deliver one (1) HIRS Engineering Test Model, whose function will be similar to that of the HIRS/4, in accordance with the specifications shown in GSFC-S-480-82. The Engineering Test Model shall be built to be capable of withstanding the same levels of qualification testing as the Protoflight Model, but does not require flight qualified parts.

9.3.1 MetOp HIRS/4 ENGINEERING MODEL

The contractor shall modify the HETM to satisfy the following MetOp requirements in order to be used as the MetOp Engineering Model.

Make necessary structural modifications to the baseplate to accommodate MetOp supplied heaters, thermostats, and thermistors and bond this hardware to the baseplate.

The thermal blanket foil shall carry a conductive layer. Each electrically conductive layer of MLI shall be grounded to structure. Surfaces which are smaller than 100 cm² do not need to be grounded to structure. The number of bonding points per sheet of MLI material shall be at least two points, at diagonal corners. The DC resistance between the MLI bonding point and any point belonging to the metallized face of any foil shall be less than 50 Ω .

Provide connector savers.

The magnetic materials with their magnetic characteristics shall be listed.

Provide additional MetOp specific information for the MetOp EM preship review in an as agreed upon format by ITT/NASA/NOAA. (This is in addition to the POES preship package.)

Add a resistor to either the short wave or long wave detector as was done for the susceptibility testing.

Provide a flight cover for the J08 connector.

9.3.2 MetOp FLIGHT MODELS

9.3.2.1 Thermal Blanket Grounding, Connector Savers, Flight Connection Cover

The contractor shall make modifications necessary to the MetOp HIRS instruments, H306 and H307, to satisfy the following MetOp requirements.

Provide connector savers.

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The thermal blanket foil shall carry a conductive layer. Each electrically conductive layer of MLI shall be grounded to structure. Surfaces which are smaller than 100 cm² do not need to be grounded to structure. The number of bonding points per sheet of MLI material shall be at least two points, at diagonal corners. The DC resistance between the MLI bonding point and any point belonging to the metallized face of any foil shall be less than 50 Ω .

Provide a flight cover for the J08 connector.

9.3.3 MetOp REQUIRED ACCEPTANCE DATA PACKAGE

In addition to the POES end item data package, the following shall be provided for each MetOp instrument with the instrument deliveries. This package shall be provided in electronic format on a CD ROM.

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- Declared Component List. All components to be used in the MetOp Instrument Interface shall be listed in a Declared Component List.
- Acceptance Data Package. The Acceptance Data Package shall constitute the basis for formal acceptance of each deliverable item and shall be delivered within 30 days of the instrument delivery. The contents of this package are defined below.
 - Table of Contents
 - Shipping documents/equipment identification
 - Certificate of Conformance (w.r.t. MetOp ICD) -- this will be in the form of a Compliance Matrix
 - As built configuration status list
 - Interface drawings (other drawings may be delivered as necessary)
 - Non-conformance reports (without analysis) (w.r.t. CFI ICD)
 - Deviations and waiver requests (w.r.t. CH ICD)
 - Test reports or test summary reports
 - Operations and maintenance manuals to cover procedures for:
 - Packing/unpacking
 - Incoming inspection
 - Mechanical integration and alignment, if any (complementary inputs in support of system level procedures)
 - Electrical integration (complementary inputs in support of system level procedures)
 - Health check (complementary inputs in support of system level procedures)
 - Instrument specific inputs for system level testing (e.g., TB/TV test, EMC test)
 - Special operations (e.g., mechanism locking/unlocking, pyro testing, red tag item removal/installation, green tag item installation)
 - Safety procedures

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- Flight operation manual for the MetOp configuration including instruments inputs to system database (includes in-orbit and ground operations)
- Instrument calibration database
- Open work/deferred work/open tests
- Historical record sheets (logbooks) including operating time/cycles records, connectors mating records
- Age sensitive items records/life limited items status list
- Safety
 - Residential hazards sheet (if applicable)
 - Proof load certificates for handling equipment
- Declared materials and processes lists (for cleanliness/contamination issues)
- EMI test Procedures and data sheets for Radiated Susceptibility, Radiated Emissions, Conducted Susceptibility and Conducted Emissions.
- Alignment Chart with field of view alignment data.
- Vibration test procedure and data sheets, including post vibration plots.
- Instrument on time log, to be used during continuing use on the spacecraft.
- Connector mate/demate log, to be used during continuing use on the spacecraft.
- Procedures for the following operations.
 - o Installation of the optical cube
 - o Blanket installation
 - o Dust cover installation
 - o Bagging the instruments

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9.4 MetOp SPECIFIC ACTIVITIES

9.4.1 RADIATED EMISSIONS AND CONDUCTED EMISSIONS TESTS

The contractor shall augment the HIRS test program to include special MetOp EMC characterization tests. Specifically, the contractor will add MetOp unique emissions tests and/or augmentations to existing POES based test procedures to cover not only all the GIIS/UIS requirements, but also the emissions tests requirements per the MetOp AVHRR ICD (MO-IC-MMT-H1-0001, Rev. A, sections 4.3.1.1 and 4.3.1.3). Facility limitations applicable to the baseline test program will be acceptable. The test results are to be documented in a special test report for each instrument and results are for characterization purposes only.

10 INTEGRATION AND LAUNCH SUPPORT

10.1 POES SUPPORT

10.1.1 POES INTEGRATION AND TEST SUPPORT

The contractor shall provide the personnel and materials necessary for supporting the integration and testing of all of the flight HIRS and AVHRR instruments on their respective POES spacecraft. Technical support shall be provided at the contractor's facility from shipment of the instrument through launch. This support shall include the following activities. 1) Investigation of discrepancy reports opened at the spacecraft vendor, 2) Investigation of anomalous behavior of delivered instruments, 3) Response to action items, 4) Review of data from spacecraft level testing. The level of support shall be consistent with nominal spacecraft testing. Support of significant anomalies shall be requested as described in section 3.1.1 of this statement of work.

All build and test packages for all HIRS/2/3/4 and AVHRR/2/3 instruments shall be stored. The HIRS/2 and AVHRR/2 instrument data shall be stored in hard copy form. The HIRS/3, HIRS/4 and AVHRR/3 data shall be stored in hard copy form and electronically.

Technical support for anomalous behavior that occurs during a spacecraft test shall be provided within three business days. During launch call up testing, support shall be provided within one calendar day.

Support shall be provided at the spacecraft vendor facility for the following activities for NOAA-N and NOAA-N'. 1) Thermal Vacuum testing, 2) EMI testing, 3) pre-ship SEPET testing, 4) Yearly storage inspections and SEPET testing, 5) Pre-ship inspection and optical cleaning of instruments. For each test, the contractor shall provide an evaluation of the performance of the HIRS and AVHRR. Preliminary results shall be available prior to the contractor leaving the test site. Results of each test shall be formally documented in a test report to be submitted 30 calendar days following the completion of each test. The test report shall include a summary of the test performed, how the instruments were evaluated, and a summary of the instruments' performance, including any anomalous behavior.

Technical support shall be available at the spacecraft vendor for planned activities within sixty calendar days of notification.

Each year, either one engineering and/or programmatic review shall be supported at GSFC or one Technical Interchange Meeting shall be supported at the spacecraft contractor facility in Sunnyvale, California.

10.1.2 POES LAUNCH AND ON-ORBIT SUPPORT

The contractor shall provide the personnel and materials necessary for supporting launch of NOAA-N and NOAA-N'. Support shall be provided at the launch site for the following activities. 1) Pre launch SEPET data review, 2) AVHRR Glint shield installation, 3) Pre-launch optical inspection of the instruments, 5) cooler inspection and final cooler door closure. In addition, launch support shall be provided at the satellite operations control center for the launch and for the instrument IR channel activations.

Technical support shall be provided for instrument performance evaluation at the contractor's facility during the on orbit operational life of the instruments. Technical support for anomalies that affect mission success shall be provided within 3 business days. Responses to all other requests shall be submitted within sixty calendar days.

10.1.3 TEST EQUIPMENT STORAGE AND MAINTENANCE

The contractor shall maintain and store all POES government furnished equipment appearing on the Government Furnished Equipment (GFE) list until the launch of the final HIRS and AVHRR. This includes, but is not limited to, special test equipment, ground support equipment, spare parts, components and assemblies and any other associated equipment.

The equipment shall be stored in accordance with the POES AVHRR and HIRS Storage Plan, ITT document 8202301, and be available for use within one month of government request.

The contractor shall assure that all required contractor owned equipment shall be maintained and available for use until the launch of the final HIRS and AVHRR instruments.

An off site storage facility, if required, shall be identified, inspected and approved by government sources. The facility shall be climate controlled and secure with limited access.

The POES FTP data archive at ITT and the POES Data analysis center shall remain available and their capabilities maintained. Hardware and software shall be maintained as necessary. The POES FTP data archiving capabilities shall be extended to include the downloading and storage of on-orbit data. This shall include the ability to read, process, and analyze 1-B on-orbit data. The spacecraft instrument data analysis system shall be maintained at the POES spacecraft vendor. The MetOp TBCU and MIB/DAN System shall be maintained by the contractor and stored at the spacecraft integrator facility. Normal maintenance shall be performed in conjunction with required field test support.

10.2 MetOp SUPPORT

10.2.1 MetOp ENGINEERING MODEL INTEGRATION AND TEST SUPPORT

The contractor shall supply the necessary support for the integration and testing of the AVHRR and HIRS on the MetOp engineering model of the PLM. This support shall include pre test analysis and preparations, test support both at the MetOp facilities and at ITT, and evaluation of the instruments' performance during the testing. Activities requiring support at the Astrium, GmbH facility in Friedrichshafen, Germany are CE/CS testing and System Functional Testing (SFT). Support is then required for the transport of the EGSE from Astrium to the ESTEC facility in Noordwijk, Holland. Activities requiring support at the ESTEC facility include a post ship test of the EGSE and TB/TV testing.

For each test, the contractor shall provide an evaluation of the performance of HIRS and AVHRR. Results of each test shall be formally documented in a test report to be submitted 30 days following the completion of each test.

10.2.2 MetOp FLIGHT MODEL INTEGRATION AND TEST SUPPORT

The contractor shall supply the necessary support for the integration and testing of the AVHRR and HIRS onto the MetOp PFM, FM2, and FM3 payload modules (PLMs). This support shall include pre test analysis and preparations, test support both at the MetOp facilities and at ITT for evaluation of the instruments' performance during the testing. Activities requiring support at the Astrium, GmbH facility in Friedrichshafen, Germany are CE/CS testing and System Functional Testing (SFT). Support is then required for the transport of the EGSE from Astrium to the ESTEC facility in Noordwijk, Holland. Activities requiring support at the ESTEC facility include a post ship test of the EGSE, and TB/TV.

For each test, the contractor shall provide an evaluation of the performance of

HIRS and AVHRR. Results of each test shall be formally documented in a test report to be submitted 30 days following the completion of each test.

Technical support shall be provided at the contractor's facility to resolve interface issues and evaluate instrument at performance any time from shipment through launch that does not require on site contractor support. Technical support shall be available within three business days of any issue that impacts the spacecraft testing. Recommendations on all other issues are required within sixty calendar days.

The MetOp FTP data archive at ITT and the MetOp data analysis center shall remain available and their capabilities maintained. Hardware and software shall be maintained as necessary. The contractor shall maintain a database of instrument test data and reports that are MetOp specific.

10.2.2.1 MetOp 1 Satellite Test Support

The contractor shall provide support in Toulouse, France at the facility listed below for the following MetOp 1 satellite level activities. Each activity will be conducted on a 12 hour a day, 5 day a week schedule, and each test will last the duration shown.

- 1) CE/CS testing, at the Astrium EMI facility for a duration of 10 days,
- 2) RFC testing at the Interspace EMI facility for a duration of 2 days,
- 3) Autocompatibility Testing at the Interspace EMI facility for a duration of 13 days,
- 4) Sine Vibration testing at the Interspace Vibration facility for a duration of 9 days. For each test, the contractor shall provide an evaluation of the performance of the HIRS and AVHRR. A preliminary evaluation shall be provided at the conclusion of the test. Test results shall be formally documented in a test report to be submitted 30 days following the completion of each test. For the vibration test, the contractor shall install and remove accelerometers required to monitor the instruments during that test.

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10.2.3 MetOp LAUNCH AND ON-ORBIT SUPPORT

The contractor shall provide the personnel and materials necessary for supporting the launch of the first MetOp spacecraft. Support shall be provided at the spacecraft integrator for the flight acceptance review. Support shall be provided at the launch site for 60 calendar days prior to the planned launch. The contractor shall perform an on orbit evaluation of the instruments. Both engineering and science telemetry shall be included in the evaluation and the performance compared to ground test data and specifications. A test plan shall be submitted for approval six months prior to the planned launch date. The evaluation shall be complete within six months from the date of launch.

The contractor shall provide the personnel and materials necessary for supporting the launch of the second MetOp spacecraft. Support shall be provided at the spacecraft integrator for the following activities. 1) system functional testing, 2) thermal vacuum testing, 3) vibration testing, 4) flight acceptance review. Support shall be provided at the launch site for 60 calendar days prior to the planned launches. Technical support shall be provided at the contractor's facility to evaluate instrument performance during the 9 month test period preceding the launch. The contractor shall perform an on orbit evaluation of the

instruments. Both engineering and science telemetry shall be included in the evaluation and the performance compared to ground test data and specifications. A test plan shall be submitted for approval six months prior to the planned launch date. The contractor shall provide a progress report including all completed tests two months following the launch date. The tests to be completed by this time shall be agreed upon at the time that the plan is approved.

Technical support shall be provided for instrument performance evaluation at the contractor's facility during the on orbit operational life of the instruments. Technical support for anomalies that affect mission success shall be provided within 3 business days. Responses for all other requests shall be submitted within 60 calendar days.

10.3 SPACECRAFT ELECTRICAL GROUND SUPPORT EQUIPMENT

The contractor shall provide the necessary Electrical Ground Support Equipment (EGSE) to perform instrument evaluations on both the AVHRR and the HIRS while mounted on either the POES or MetOp spacecraft. The EGSE to interface with the MetOp and POES spacecraft shall be interchangeable. The interface to the MetOp spacecraft is defined in paragraphs 8.2.2 and 9.2.2 of this Statement of Work. To support the POES spacecraft testing, the EGSE shall ingest and store the POES spacecraft High Resolution Picture Transmission (HRPT) data, demodulated, bi-phased 667 kbs, from an output of the Spacecraft EGSE. The HRPT data format is described in Section 5 of the Advanced TIROS-N Program Programming and Control Handbook for NOAA-KLM.

For the POES and MetOp spacecraft testing, the EGSE shall process the HIRS and AVHRR science and housekeeping data and perform a real time quick-look analysis that will identify potential anomalous events in the science data during various spacecraft level testing. In addition, in the offline mode, the EGSE shall process the HIRS and AVHRR science and housekeeping data and perform a detailed science analysis including image processing, statistics and noise analysis. An offline science report shall be generated by manually selecting a data file and activating the offline analysis task.

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The EGSE shall provide a fully automated data evaluation tool. It shall perform real time science analysis and limit checking on a pixel by pixel basis. It shall be capable of real time trending of science and housekeeping telemetry.

The EGSE shall perform limit checking of all telemetry and shall be capable of trending all telemetry. The EGSE shall include a real time data storage capability such that twenty four hours of continuous HIRS and AVHRR POES or MetOp data can be stored. The EGSE shall be able to retrieve this data and act upon it as if it were real time data. Permanent storage and retrieval capability shall be provided.

EGSE that can function as a spare for either a DAN or a MIB shall be provided to each of two MetOp spacecraft testing facilities.

10.4 Thermal Vacuum Chamber

The contractor shall maintain a single thermal vacuum chamber for the exclusive use of the POES program. This chamber shall be able to be used to fully test either the HIRS or the AVHRR. Changing the configuration from an AVHRR test set up to a HIRS test set up shall take no longer than 15 calendar days.

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11.0 SPARE PARTS

The contractor shall provide sufficient spare parts (approximately 20% of total parts) to assure the expeditious progress of instrument development and reliable ground support equipment operation during the course of this contract.

11.1 FILTER/CHOPPER SPARE MOTOR

A spare motor shall be provided that meets all of the specifications as the flight filter/chopper motor. The lubricant in the bearings of the spare motor shall be Pennzane oil. The design life of the filter/chopper motor with the Pennzane oil lubricant shall be demonstrated with a life test.

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12.0 PERFORMANCE ASSURANCE

The contractor shall conduct quality and reliability activities on this contract in accordance with the requirements of the AVHRR/3 and HIRS/3/4 PAR specification S-480-29.1 Rev. G, and its Clarification Addendum.

The contractor shall provide post delivery instrument support at the NOAA spacecraft contractor facilities through the launch of NOAA-M. (Reference AVHRR Unique Interface Specification IS-20029950 and HIRS Tiros-N Unique Interface Specification IS 2285780.)

APPENDIX A

GLOSSARY

APPENDIX AGLOSSARY

ABPL	As-built parts list
AC	Actual Cost
ACA	After Contract Award
ADC	After date of contract
AMSU	Advanced Microwave Sounding Unit
AOC	After Award of Contract
ARO	After receipt of order
AVHRR/3	Advanced Very High Resolution Radiometer/3
BCWP	Budgeted cost of the work Performed
BCWS	Budgeted Cost of the Work Scheduled
BCE	Bench Check Equipment
BTC	Bench Test Cooler
c	Centigrade
CCB	Configuration Control Board
CDR	Critical Design Review
CM	Configuration Management
CONFIG.	Configuration
CPM	Critical Path Method
DPA	Ground Support Equipment
DSHD	Double Sided High Density
EEE	Electrical, Electronic and Electromechanical (part)
EM	Engineering Model
EMI	Electromagnetic Interference
ETM	Engineering Test Model
FM	Flight Model
GFE	Government Furnished Equipment
GIDEP	Government-Industry Data Exchange Program

GIIS	General Instrument Interface Specification
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HIRS/3	High Resolution Infrared Radiation Sounder/3 (20km IFOV)
HIRS/4	High Resolution Infrared Radiation Sounder/4 (10km IFOV)
INSTR.	Instrument
K	Kelvin
MetOp	Meteorological Operational Platform
MGT.	Management
MRB	Material Review Board
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data and Information Service
NOAA	National Oceanic and Atmospheric Administration
NSPAR	Nonstandard Parts Approval Request
NSPL	NASA Standard Parts List
O&M	Operations and Maintenance
OTM	Optical Test Model
PA	Performance Assurance
PAR	Performance Assurance Requirements
PC	Personal Computer
PDR	Preliminary Design Review
PER	Pre-Environmental Review
PF	Protoflight
PM	Protoflight Model
POES	Polar Operational Environmental Satellites
PPL	Preferred Parts List

PRT	Platinum Resistance Thermometer
PSR	Pre-Ship Review
PTU	Portable Test Unit
S/C	Spacecraft
SCDR	System Concept Design Review
SCR	System Concept Review
SOW	Statement of Work
STU	Special Test Unit
TMP	Temperature
TO	Technical Officer
TOVS	Tiros Operational Vertical Sounder
UIIS	Unique Instrument Interface Specification
WBS	Work Breakdown Structure